New York State
DEPARTMENT OF ENVIRONMENTAL CONSERVATION

Division of Water

Salt Kill
Biological Assessment

2004 Survey

New York State
Department of Environmental Conservation

George E. Pataki, *Governor*

Erin M. Crotty, *Commissioner*

BIOLOGICAL STREAM ASSESSMENT

Salt Kill
Albany County, New York

Survey date: July 26, 2004
Report date: October 16, 2004

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CONTENTS

Stream: Salt Kill, Albany County

Reach: above and below property of Norlite Corporation, Cohoes, New York

Background:

The Stream Biomonitoring Unit sampled the Salt Kill in Cohoes, New York, on July 26, 2004. The sampling was in response to a request by Carol Lamb-Lafay, NYS DEC Region 4, to determine any impacts to aquatic invertebrate life in the Salt Kill in relation to discharges or runoff from the Norlite Corporation facilities. Don Canestrari, DEC site monitor, and Brian Decatur of Norlite assisted in the survey, facilitating access to the sampling sites.

The purpose of the sampling was to determine the condition of resident aquatic communities of benthic macroinvertebrates upstream and downstream of the Norlite facility. Four traveling kick samples were taken in riffle areas at one upstream site, and one downstream site, using methods described in the Quality Assurance document (Bode et al., 2002) and summarized in Appendix I. The contents of each sample were field-inspected to determine major groups of organisms present, and then preserved in alcohol for laboratory inspection of 100-specimen subsamples from three samples at each site. Macroinvertebrate community parameters used in the determination of water quality included species richness, biotic index, EPT richness, and percent model affinity (see Appendices II and III). Table 2 provides a listing of sampling sites, and Table 3 provides a listing of all species collected in the present survey. This is followed by macroinvertebrate data reports, including raw data from each site.

Results and Conclusions:

1. Based on resident macroinvertebrate communities, water quality in the Salt Kill was assessed as slightly impacted both upstream and downstream of the Norlite Corporation facility. Compared to the upstream control site, all metrics worsened slightly at the downstream site, but no Biological Impairment Criteria were exceeded for any metrics.

2. Water quality has improved substantially in the Salt Kill compared to a sample taken near the downstream site in 1992 which was assessed as severely impacted. The improvement is undoubtedly the result of diverting the Norlite discharge from the Salt Kill to the Mohawk River.

Discussion

The Salt Kill creek originates in Boght Corners in the town of Colonie, and flows in an easterly direction approximately 6 miles before emptying into the Hudson River at Green Island. Most of its drainage is residential, although large portions of the immediate buffer zone consist of wooded areas and brush land. For 0.6 miles of its length it flows through the property of the Norlite Corporation in Cohoes, which mines shale and processes it in rotary kilns to produce light-weight aggregate, used in concrete, fill, and construction uses. The present sampling was conducted to determine if the Norlite facility caused any impacts to the aquatic communities of benthic macroinvertebrates of the Salt Kill.

The Salt Kill was previously sampled by the Stream Biomonitoring Unit in 1992 immediately downstream of the Norlite facility. This sampling produced only one macroinvertebrate individual, and water quality was assessed to be severely impacted (Bode et al., 1993). The paucity of aquatic life was attributed to three factors: an unstable substrate of gravel and clay, apparent intermittent flow conditions, and poor water quality. At the time of sampling, dissolved oxygen in the stream was measured at 0.05 mg/l, and specific conductance was 2860 μmhos. At that time, the stream received poorly treated Norlite wastes, including heated effluent from the rotary kilns. In 1995, a new treatment facility was constructed, and the treated effluent was diverted to the Mohawk River rather than the Salt Kill.

In the present survey of the Salt Kill, two sites were sampled: one immediately upstream of the Norlite facility, and one at the downstream edge of the Norlite property. Four samples were taken at each site, of which 3 were processed. Procedures for determining significant impact used Biological Impairment Criteria methods (Bode et al., 1990), also contained in the current Quality Assurance document (Bode et al., 2002).

Based on resident macroinvertebrate communities, water quality in the sampled reach of the Salt Kill was assessed as slightly impacted at both sites (Figure 1). Compared to the upstream control site (Station 0), all metrics worsened slightly at the downstream site (Station 1), but Biological Impairment Criteria were not exceeded for any metrics. Macroinvertebrate communities at both sites were dominated by riffle beetles, caddisflies, scuds, and midges.

	UPSTREAM				DOWNSTREAM			
INDIVIDUAL SAMPLES	00-A	00-B	00-C	AVG	01-A	01-B	01-C	AVG
Species Richness	26	26	24	25	22	21	25	23
Biotic Index	5.63	5.08	5.16	5.29	6.25	5.18	5.21	5.55
EPT Richness	4	6	5	5	6	3	4	4
Percent Model Affinity	52	56	58	55	58	40	53	50
Species dominance	19	24	21	21	28	34	40	34

SUMMARY					
	UPSTREAM	DOWNSTREAM	CHANGE	CRITERION	EXCEEDANCE ?
Species Richness	25	23	-2	-8	N
Biotic Index	5.29	5.55	+.26	+1.5	N
EPT Richness	5	4	-1	-4	N
Percent Model Affinity	55	50	-5	-20	N
Species dominance	21	34	+13	+15	N

Impact Source Determination (ISD, Table 1, Appendix X) was used to determine cause of impact at the two sites. The consensus of this analysis was that both sites exhibited effects of nonpoint source nutrient enrichment and effects of toxic inputs, most likely caused by urban run-off. The stream reportedly is dry during portions of low-flow years, and this also is a likely limiting factor on the macroinvertebrate communities.

The macroinvertebrate data from this sampling showed that the Norlite facility had a small worsening effect on the stream biota, but did not exceed the Biological Impairment Criteria and it did not affect the water quality assessment category of the stream. Compared to 1992 conditions in the stream, water quality has improved substantially, undoubtedly due to the removal of the Norlite effluent, which is now discharged into the Mohawk River.

Literature Cited:

Bode, R. W., M. A. Novak, L. E. Abele, D. L. Heitzman, and A. J. Smith. 2002. Quality assurance work plan for biological stream monitoring in New York State. New York State Department of Environmental Conservation, Technical Report, 115 pages.

Bode, R. W., M. A. Novak, and L. E. Abele. 1993. 20 year trends in water quality of rivers and streams in New York State, based on macroinvertebrate data. New York State Department of Environmental Conservation, Technical Report, 196 pages.

Bode, R. W., M. A. Novak, and L. E. Abele. 1990. Biological impairment criteria for flowing waters in New York State. New York State Department of Environmental Conservation, Technical Report, 110 pages.

Overview of field data

On the date of sampling, July 26, 2004, the Salt Kill at the sites sampled was 3 meters wide, 0.1 meters deep, and had a current speed of 50 cm/sec in riffles. Dissolved oxygen was 9.7-9.8 mg/l, specific conductance was 1267-1415 µmhos, pH was 8.1-8.4 and the temperature was 21 °C (72 °F). Measurements for each site are found on the field data summary sheets.

Figure 1. Biological Assessment Profile of index values, Salt Kill, 2004. Values are plotted on a normalized scale of water quality. The line connects the mean of the four values for each site, representing species richness, EPT richness, Hilsenhoff Biotic Index, and Percent Model Affinity. See Appendix IV for more complete explanation.

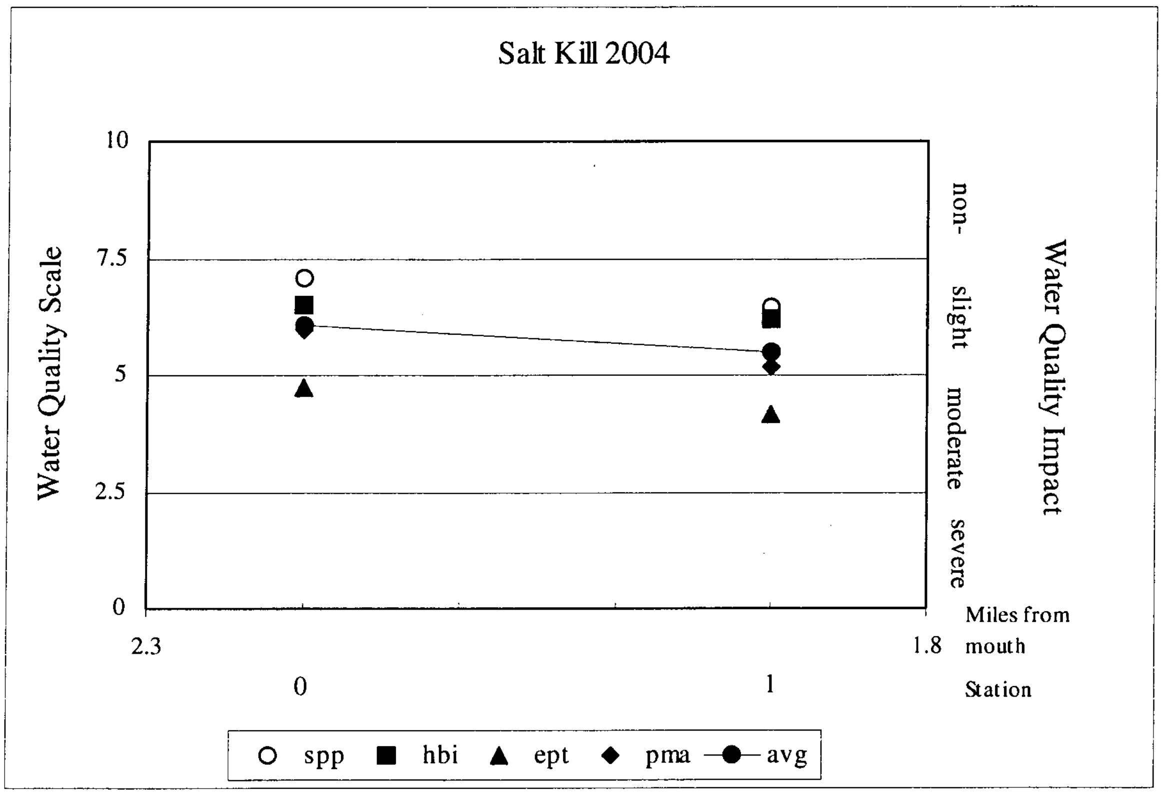

Table 1. Impact Source Determination, Salt Kill, 2004. Numbers represent similarity to community type models for each impact category. The highest similarities at each station are highlighted. Similarities less than 50% are less conclusive. Highest numbers represent probable type of impact. See Appendix X for further explanation.

	STATION					
Community Type	SALT-00A	SALT-00B	SALT-00C	SALT-01A	SALT-01B	SALT-01C
Natural: minimal human impacts	36	43	45	40	36	38
Nutrient additions; mostly nonpoint, agricultural	48	64	61	55	51	51
Toxic: industrial, municipal, or urban run-off	45	62	47	51	55	60
Organic: sewage effluent, animal wastes	36	45	36	39	34	42
Complex: municipal/industrial	46	50	46	49	45	39
Siltation	39	52	43	41	34	38
Impoundment	44*	56	50	54*	56*	60*

STATION	COMMUNITY TYPE
SALT-00A	Nutrients, toxics
SALT-00B	Nutrients, toxics
SALT-00C	Nutrients
SALT-01A	Nutrients, toxics
SALT-01B	Nutrients, toxics
SALT-01C	Toxics

*Designations of impoundment effects are considered spurious

TABLE 2. STATION LOCATIONS FOR SALT KILL, ALBANY COUNTY, NY

STATION	LOCATION
00	Cohoes, New York Upper end of Norlite Corp. property, opposite quarry Latitude/Longitude 42° 45' 21"; 73° 42' 20" 2.2 stream miles above mouth
01	Cohoes, New York Norlite Corp. property, between railroad and Route 32 Latitude/Longitude 42° 45' 16"; 73° 42' 04" 1.9 stream miles above mouth

Figure 2	Site Location Map	Salt Kill

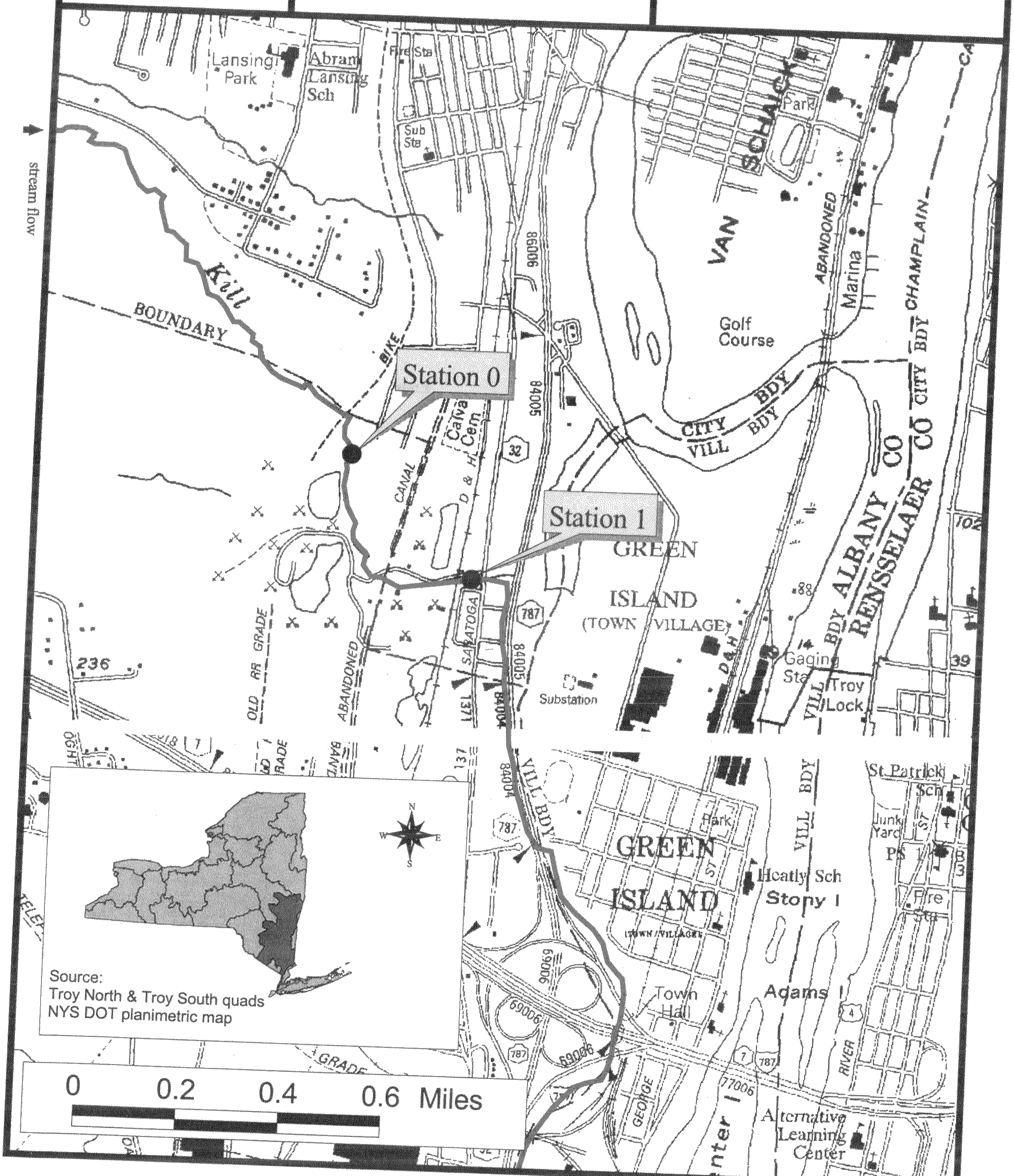

TABLE 3. MACROINVERTEBRATE SPECIES COLLECTED IN THE SALT KILL, ALBANY COUNTY, NEW YORK, 2004.

PLATYHELMINTHES
- TURBELLARIA
  - Undet. Turbellaria

ANNELIDA
- OLIGOCHAETA
  - LUMBRICIDA
    - Undet. Lumbricina
  - TUBIFICIDA
    - Tubificidae
      - Undet. Tub. w/o cap setae

MOLLUSCA
- GASTROPODA
  - Physidae
    - Physella sp.
  - Planorbidae
    - Undet. Planorbidae

ARTHROPODA
- CRUSTACEA
  - ISOPODA
    - Asellidae
      - Caecidotea sp.
  - AMPHIPODA
    - Gammaridae
      - Gammarus sp.
  - DECAPODA
    - Cambaridae
      - Undet. Cambaridae
- INSECTA
  - EPHEMEROPTERA
    - Baetidae
      - Acentrella sp.
      - Baetis flavistriga
      - Baetis intercalaris
  - COLEOPTERA
    - Psephenidae
      - Ectopria nervosa
      - Psephenus herricki
    - Elmidae
      - Dubiraphia quadrinotata
      - Dubiraphia vittata
      - Macronychus glabratus
      - Optioservus fastiditus
      - Optioservus ovalis
      - Optioservus sp.
      - Stenelmis crenata
  - MEGALOPTERA
    - Sialidae
      - Sialis sp.
  - TRICHOPTERA
    - Philopotamidae
      - Chimarra aterrima?
    - Hydropsychidae
      - Cheumatopsyche sp.
      - Hydropsyche betteni
      - Hydropsyche morosa
      - Hydropsyche slossonae
      - Hydropsyche sparna
      - Hydropsyche sp.
  - DIPTERA
    - Tipulidae
      - Antocha sp.
      - Dicranota sp.
      - Tipula sp.
      - Undet. Tipulidae
    - Simuliidae
      - Simulium sp.
    - Empididae
      - Hemerodromia sp.
    - Muscidae
      - Undet. Muscidae
    - Chironomidae
      - Thienemannimyia gr. sp.
      - Diamesa sp.
      - Pagastia orthogonia
      - Cricotopus vierriensis
      - Orthocladius nr. dentifer
      - Paracricotopus sp.
      - Parametriocnemus lundbecki
      - Tvetenia bavarica gr.
      - Tvetenia vitracies
      - Microtendipes pedellus gr.
      - Polypedilum aviceps
      - Polypedilum flavum
      - Polypedilum laetum
      - Rheotanytarsus exiguus gr.
      - Tanytarsus glabrescens gr.

STREAM SITE: Salt Kill Station 00
LOCATION: Cohoes, NY, upper end of Norlite Corp. property, opposite quarry
DATE: July 14, 2004
SAMPLE TYPE: Kick sample
SUBSAMPLE: 100 individuals

			A	B	C
PLATYHELMINTHES		Undet. Turbellaria	1	2	.
ANNELIDA					
OLIGOCHAETA	Tubificidae	Undet. Tub. w/o cap setae	4	.	2
MOLLUSCA					
GASTROPODA	Physidae	Physella sp.	1	.	.
ARTHROPODA					
CRUSTACEA					
ISOPODA	Asellidae	Caecidotea sp.	2	2	1
AMPHIPODA	Gammaridae	Gammarus sp.	19	6	10
INSECTA					
EPHEMEROPTERA	Baetidae	Baetis flavistriga	2	2	3
		Baetis intercalaris	1	8	3
COLEOPTERA	Psephenidae	Ectopria nervosa	1	.	1
		Psephenus herricki	2	1	2
	Elmidae	Dubiraphia vittata	1	.	.
		Optioservus fastiditus	7	4	.
		Optioservus sp.	.	.	9
		Stenelmis crenata	19	24	21
MEGALOPTERA	Sialidae	Sialis sp.	.	.	2
TRICHOPTERA	Philopotamidae	Chimarra aterrima?	.	1	.
	Hydropsychidae	Cheumatopsyche sp.	2	19	10
		Hydropsyche betteni	.	1	.
		Hydropsyche slossonae	3	7	4
		Hydropsyche sparna	.	.	1
DIPTERA	Tipulidae	Antocha sp.	.	.	1
		Dicranota sp.	1	2	3
		Tipula sp.	.	1	3
		Undet. Tipulidae	.	1	.
	Simuliidae	Simulium sp.	1	1	1
	Empididae	Hemerodromia sp.	2	2	1
	Chironomidae	Thienemannimyia gr. sp.	7	2	7
		Cricotopus vierriensis	3	1	2
		Orthocladius nr. dentifer	5	1	.
		Paracricotopus sp.	.	1	.
		Parametriocnemus lundbecki	5	4	8
		Microtendipes pedellus gr.	.	.	2
		Polypedilum aviceps	1	1	.
		Polypedilum flavum	1	1	1
		Polypedilum laetum	5	.	2
		Rheotanytarsus exiguus gr.	2	1	.
		Tanytarsus glabrescens gr.	2	4	.

	A	B	C
SPECIES RICHNESS (ave. = 25, good)	26	26	24
BIOTIC INDEX (ave. = 5.29, good)	5.63	5.08	5.16
EPT RICHNESS (ave. = 5, poor)	4	6	5
MODEL AFFINITY (ave. = 55, good)	52	56	58
ASSESSMENT OF IMPACT	slight	slight	slight
IMPACT SOURCE	Nutrient enrichment (58%) Toxic (51%)		

STREAM SITE:	Salt Kill Station 01
LOCATION:	Cohoes, NY, lower end of Norlite Corp. property, between railroad and Route 32
DATE:	July 14, 2004
SAMPLE TYPE:	Kick sample
SUBSAMPLE:	100 individuals

			A	B	C
OLIGOCHAETA	Lumbricida	Undet. Lumbricina	1	.	.
	Tubificidae	Undet. Tub. w/o cap setae	2	1	2
MOLLUSCA					
GASTROPODA	Planorbidae	Undetermined Planorbidae	.	1	.
ARTHROPODA					
CRUSTACEA					
ISOPODA	Asellidae	Caecidotea sp.	2	9	3
AMPHIPODA	Gammaridae	Gammarus sp.	18	15	3
DECAPODA	Cambaridae	Undet. Cambaridae	.	1	1
INSECTA					
EPHEMEROPTERA	Baetidae	Acentrella sp.	1	.	.
		Baetis flavistriga	1	2	4
		Baetis intercalaris	5	3	2
COLEOPTERA	Psephenidae	Ectopria nervosa	1	.	.
		Psephenus herricki	1	1	1
	Elmidae	Dubiraphia quadrinotata	.	.	1
		Macronychus glabratus	.	1	.
		Optioservus fastiditus	.	6	.
		Optioservus ovalis	.	5	.
		Optioservus sp.	4	.	6
		Stenelmis crenata	28	34	40
MEGALOPTERA	Sialidae	Sialis sp.	.	1	2
TRICHOPTERA	Hydropsychidae	Cheumatopsyche sp.	4	.	4
		Hydropsyche betteni	3	.	.
		Hydropsyche morosa	1	.	.
		Hydropsyche sp.	.	4	1
DIPTERA	Tipulidae	Dicranota sp.	1	6	3
	Empididae	Hemerodromia sp.	3	.	1
	Muscidae	Undet. Muscidae	.	.	1
	Chironomidae	Thienemannimyia gr. sp.	5	.	3
		Diamesa sp.	3	.	.
		Pagastia orthogonia	.	2	1
		Cricotopus vierriensis	.	1	1
		Orthocladius nr. dentifer	3	1	7
		Paracricotopus sp.	.	.	1
		Parametriocnemus lundbecki	5	1	1
		Tvetenia bavarica gr.	.	.	1
		Tvetenia vitracies	2	.	.
		Polypedilum flavum	6	2	6
		Polypedilum laetum	.	3	4

	A	B	C
SPECIES RICHNESS (ave. = 23, good)	22	21	23
BIOTIC INDEX (ave. = 5.55, good)	6.25	5.18	5.21
EPT RICHNESS (ave. = 4, poor)	6	3	4
MODEL AFFINITY (ave. = 50, good)	58	40	53
ASSESSMENT OF IMPACT	slight	slight	slight
IMPACT SOURCE	Nutrient enrichment (52%) Toxic (55%)		

FIELD DATA SUMMARY				
STREAM NAME: Salt Kill REACH: Vicinity of Norlite Corporation FIELD PERSONNEL INVOLVED: Bode, Smith	DATE SAMPLED: 7/26/2004			
STATION ARRIVAL TIME AT STATION	00 12:40	01 1:15		
LOCATION	Upstream of Norlite	Downstream of Norlite		
PHYSICAL CHARACTERISTICS				
Width (meters)	3	3		
Depth (meters)	0.1	0.1		
Current speed (cm per sec.)	50	50		
Substrate (%)				
Rock (>25.4 cm, or bedrock)	10	10		
Rubble (6.35 - 25.4 cm)	30	40		
Gravel (0.2 – 6.35 cm)	30	20		
Sand (0.06 – 2.0 mm)	10	10		
Silt (0.004 – 0.06 mm)	20	20		
Embeddedness (%)	20	30		
CHEMICAL MEASUREMENTS				
Temperature (° C)	20.9	20.7		
Specific Conductance (umhos)	1267	1415		
Dissolved Oxygen (mg/l)	9.8	9.7		
pH	8.4	8.1		
BIOLOGICAL ATTRIBUTES				
Canopy (%)	50	60		
Aquatic Vegetation				
algae – suspended				
algae – attached, filamentous	present	present		
algae - diatoms				
macrophytes or moss				
Occurrence of Macroinvertebrates				
Ephemeroptera (mayflies)	X	X		
Plecoptera (stoneflies)				
Trichoptera (caddisflies)	X	X		
Coleoptera (beetles)	X	X		
Megaloptera(dobsonflies,alderflies)	X	X		
Odonata (dragonflies, damselflies)	X			
Chironomidae (midges)	X	X		
Simuliidae (black flies)				
Decapoda (crayfish)	X	X		
Gammaridae (scuds)	X	X		
Mollusca (snails, clams)				
Oligochaeta (worms)		X		
Other	X	X		
FAUNAL CONDITION	good	good		

Appendix I. BIOLOGICAL METHODS FOR KICK SAMPLING

A. Rationale. The use of the standardized kick sampling method provides a biological assessment technique that lends itself to rapid assessments of stream water quality.

B. Site Selection. Sampling sites are selected based on these criteria: (1) The sampling location should be a riffle with a substrate of rubble, gravel, and sand. Depth should be one meter or less, and current speed should be at least 0.4 meters per second. (2) The site should have comparable current speed, substrate type, embeddedness, and canopy cover to both upstream and downstream sites to the degree possible. (3) Sites are chosen to have a safe and convenient access.

C. Sampling. Macroinvertebrates are sampled using the standardized traveling kick method. An aquatic net is positioned in the water at arms' length downstream and the stream bottom is disturbed by foot, so that the dislodged organisms are carried into the net. Sampling is continued for a specified time and for a specified distance in the stream. Rapid assessment sampling specifies sampling 5 minutes for a distance of 5 meters. The net contents are emptied into a pan of stream water. The contents are then examined, and the major groups of organisms are recorded, usually on the ordinal level (e.g., stoneflies, mayflies, caddisflies). Larger rocks, sticks, and plants may be removed from the sample if organisms are first removed from them. The contents of the pan are poured into a U.S. No. 30 sieve and transferred to a quart jar. The sample is then preserved by adding 95% ethyl alcohol.

D. Sample Sorting and Subsampling. In the laboratory the sample is rinsed with tap water in a U.S. No. 40 standard sieve to remove any fine particles left in the residues from field sieving. The sample is transferred to an enamel pan and distributed homogeneously over the bottom of the pan. A small amount of the sample is randomly removed with a spatula, rinsed with water, and placed in a petri dish. This portion is examined under a dissecting stereomicroscope and 100 organisms are randomly removed from the debris. As they are removed, they are sorted into major groups, placed in vials containing 70 percent alcohol, and counted. The total number of organisms in the sample is estimated by weighing the residue from the picked subsample and determining its proportion of the total sample weight.

E. Organism Identification. All organisms are identified to the species level whenever possible. Chironomids and oligochaetes are slide-mounted and viewed through a compound microscope; most other organisms are identified as whole specimens using a dissecting stereomicroscope. The number of individuals in each species, and the total number of individuals in the subsample is recorded on a data sheet. All organisms from the subsample are archived, either slide-mounted or preserved in alcohol. Following identification of a subsample, if the results are ambiguous, suspected of being spurious, or do not yield a clear water quality assessment, additional subsampling may be required.

Appendix II. MACROINVERTEBRATE COMMUNITY PARAMETERS

1. Species richness. This is the total number of species or taxa found in the sample. Expected ranges for 100-specimen subsamples of kick samples in most streams in New York State are: greater than 26, non-impacted; 19-26, slightly impacted; 11-18, moderately impacted; less than 11, severely impacted.

2. EPT value. EPT denotes the total number of species of mayflies (Ephemeroptera), stoneflies (Plecoptera), and caddisflies (Trichoptera) found in an average 100-organism subsample. These are considered to be mostly clean-water organisms, and their presence generally is correlated with good water quality (Lenat, 1987). Expected ranges from most streams in New York State are: greater than 10, non-impacted; 6-10, slightly impacted; 2-5, moderately impacted; and 0-1, severely impacted.

3. Biotic index. The Hilsenhoff Biotic Index is a measure of the tolerance of the organisms in the sample to organic pollution (sewage effluent, animal wastes) and low dissolved oxygen levels. It is calculated by multiplying the number of individuals of each species by its assigned tolerance value, summing these products, and dividing by the total number of individuals. On a 0-10 scale, tolerance values range from intolerant (0) to tolerant (10). For purposes of characterizing species' tolerance, intolerant = 0-4, facultative = 5-7, and tolerant = 8-10. Values are listed in Hilsenhoff (1987); additional values are assigned by the NYS Stream Biomonitoring Unit. The most recent values for each species are listed in the Quality Assurance document (Bode et al., 1996). Ranges for the levels of impact are: 0-4.50, non-impacted; 4.51-6.50, slightly impacted; 6.51-8.50, moderately impacted; and 8.51-10.00, severely impacted.

4. Percent Model Affinity is a measure of similarity to a model non-impacted community based on percent abundance in 7 major groups (Novak and Bode, 1992). Percentage similarity is used to measure similarity to a community of 40% Ephemeroptera, 5% Plecoptera, 10% Trichoptera, 10% Coleoptera, 20% Chironomidae, 5% Oligochaeta, and 10% Other. Ranges for the levels of impact are: >64, non-impacted; 50-64, slightly impacted; 35-49, moderately impacted; and <35, severely impacted.

Bode, R.W., M.A. Novak, and L.E. Abele. 1996. Quality assurance work plan for biological stream monitoring in New York State. NYS DEC technical report, 89 pp.

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Lenat, D. R. 1987. Water quality assessment using a new qualitative collection method for freshwater benthic macroinvertebrates. North Carolina DEM Tech. Report. 12 pp.

Novak, M.A., and R.W. Bode. 1992. Percent model affinity: a new measure of macroinvertebrate community composition. J. N. Am. Benthol. Soc. 11(1):80-85.

Appendix III. LEVELS OF WATER QUALITY IMPACT IN STREAMS

The description of overall stream water quality based on biological parameters uses a four-tiered system of classification. Level of impact is assessed for each individual parameter, and then combined for all parameters to form a consensus determination. Four parameters are used: species richness, EPT value, biotic index, and percent model affinity. The consensus is based on the determination of the majority of the parameters; since parameters measure different aspects of the community, they cannot be expected to always form unanimous assessments. The ranges given for each parameter are based on 100-organism subsamples of macroinvertebrate riffle kick samples, and also apply to most multiplate samples, with the exception of percent model affinity.

1. Non-impacted

Indices reflect very good water quality. The macroinvertebrate community is diverse, usually with at least 27 species in riffle habitats. Mayflies, stoneflies, and caddisflies are well-represented; the EPT value is greater than 10. The biotic index value is 4.50 or less. Percent model affinity is greater than 64. Water quality should not be limiting to fish survival or propagation. This level of water quality includes both pristine habitats and those receiving discharges which minimally alter the biota.

2. Slightly impacted

Indices reflect good water quality. The macroinvertebrate community is slightly but significantly altered from the pristine state. Species richness usually is 19-26. Mayflies and stoneflies may be restricted, with EPT values of 6-10. The biotic index value is 4.51-6.50. Percent model affinity is 50-64. Water quality is usually not limiting to fish survival, but may be limiting to fish propagation.

3. Moderately impacted

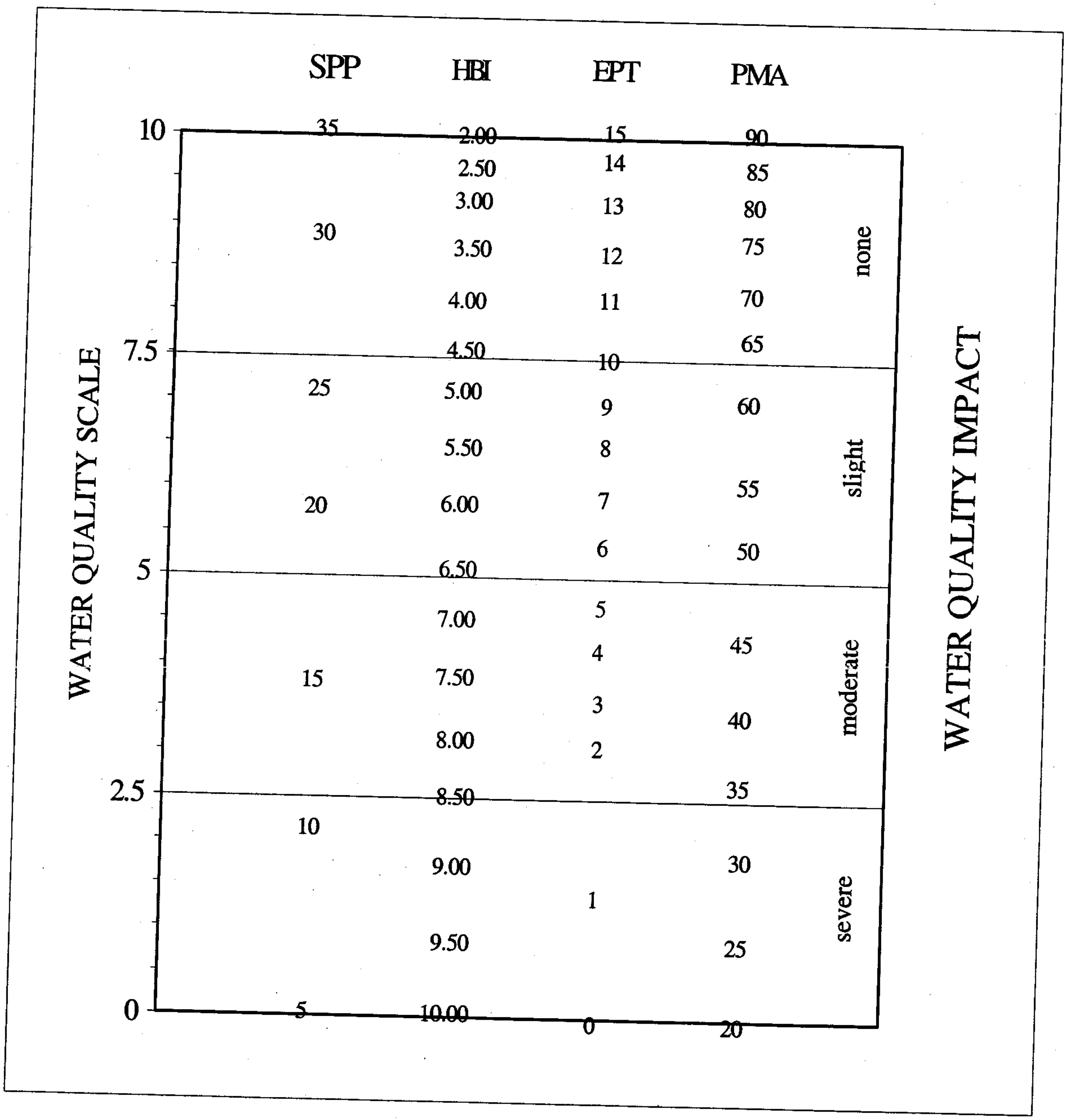
Indices reflect poor water quality. The macroinvertebrate community is altered to a large degree from the pristine state. Species richness usually is 11-18 species. Mayflies and stoneflies are rare or absent, and caddisflies are often restricted; the EPT value is 2-5. The biotic index value is 6.51-8.50. The percent model affinity value is 35-49. Water quality often is limiting to fish propagation, but usually not to fish survival.

4. Severely impacted

Indices reflect very poor water quality. The macroinvertebrate community is limited to a few tolerant species. Species richness is 10 or less. Mayflies, stoneflies, and caddisflies are rare or absent; EPT value is 0-1. The biotic index value is greater than 8.50. Percent model affinity is less than 35. The dominant species are almost all tolerant, and are usually midges and worms. Often 1-2 species are very abundant. Water quality is often limiting to both fish propagation and fish survival.

Appendix IV. BIOLOGICAL ASSESSMENT PROFILE OF INDEX VALUES

The Biological Assessment Profile of index values, developed by Mr. Phil O'Brien, Division of Water, NYS DEC, is a method of plotting biological index values on a common scale of water quality impact. Values from the four indices defined in Appendix II are converted to a common 0-10 scale as shown in the figure below.



To plot survey data, each site is positioned on the x-axis according to river miles from the mouth, and the scaled values for the four indices are plotted on the common scale. The mean scale value of the four indices represents the assessed impact for each site.

Appendix V.
WATER QUALITY ASSESSMENT CRITERIA

for non-navigable flowing waters

	Species Richness	Hilsenhoff Biotic Index	EPT Value	Percent Model Affinity#	Diversity*
Non-Impacted	>26	0.00-4.50	>10	>64	>4
Slightly Impacted	19-26	4.51-6.50	6-10	50-64	3.01-4.00
Moderately Impacted	11-18	6.51-8.50	2-5	35-49	2.01-3.00
Severely Impacted	0-10	8.51-10.00	0-1	<35	0.00-2.00

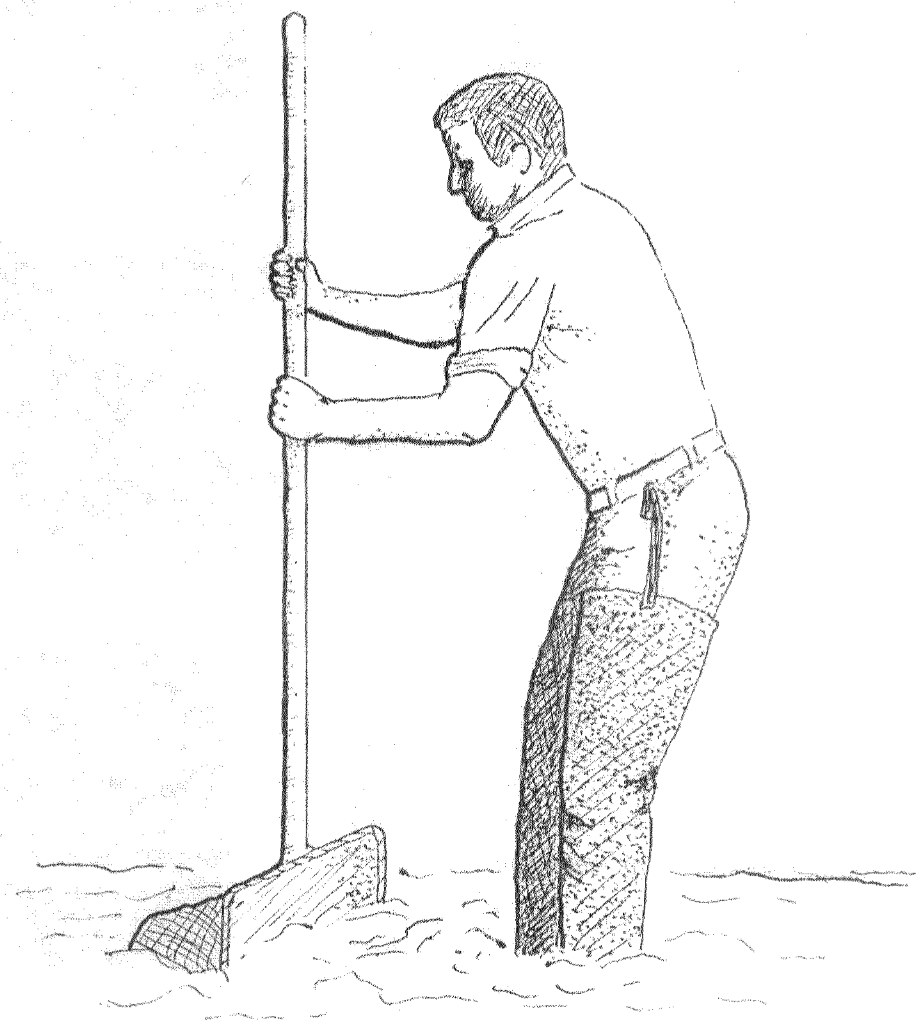
Percent model affinity criteria are used for traveling kick samples but not for multiplate samples.
* Diversity criteria are used for multiplate samples but not for traveling kick samples.

WATER QUALITY ASSESSMENT CRITERIA
for navigable flowing waters

	Species Richness	Hilsenhoff Biotic Index	EPT Value	Diversity
Non-Impacted	>21	0.00-7.00	>5	>3.00
Slightly Impacted	17-21	7.01-8.00	4-5	2.51-3.00
Moderately Impacted	12-16	8.01-9.00	2-3	2.01-2.50
Severely Impacted	0-11	9.01-10.00	0-1	0.00-2.00

Appendix VI.

THE TRAVELING KICK SAMPLE

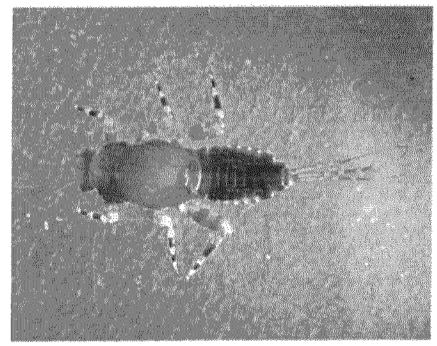


Rocks and sediment in the riffle are dislodged by foot upstream of a net; organisms dislodged are carried by the current into the net. Sampling is continued for five minutes, as the sampler gradually moves downstream to cover a distance of five meters.

Appendix VII. A.

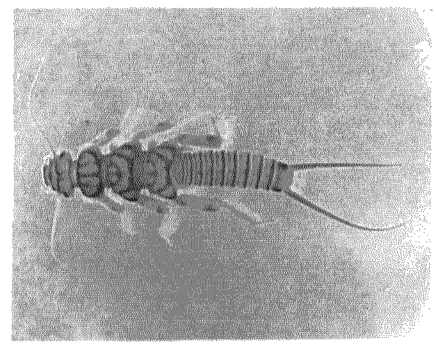
AQUATIC MACROINVERTEBRATES THAT USUALLY INDICATE GOOD WATER QUALITY

Mayfly nymphs are often the most numerous organisms found in clean streams. They are sensitive to most types of pollution, including low dissolved oxygen (less than 5 ppm), chlorine, ammonia, metals, pesticides, and acidity. Most mayflies are found clinging to the undersides of rocks.



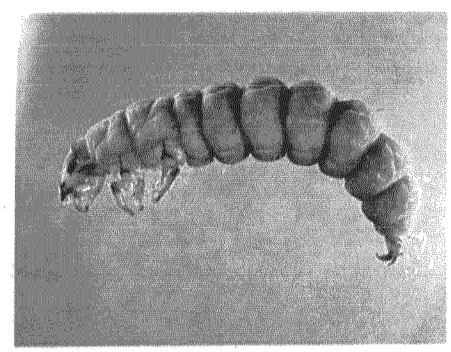
MAYFLIES

Stonefly nymphs are mostly limited to cool, well-oxygenated streams. They are sensitive to most of the same pollutants as mayflies, except acidity. They are usually much less numerous than mayflies. The presence of even a few stoneflies in a stream suggests that good water quality has been maintained for several months.



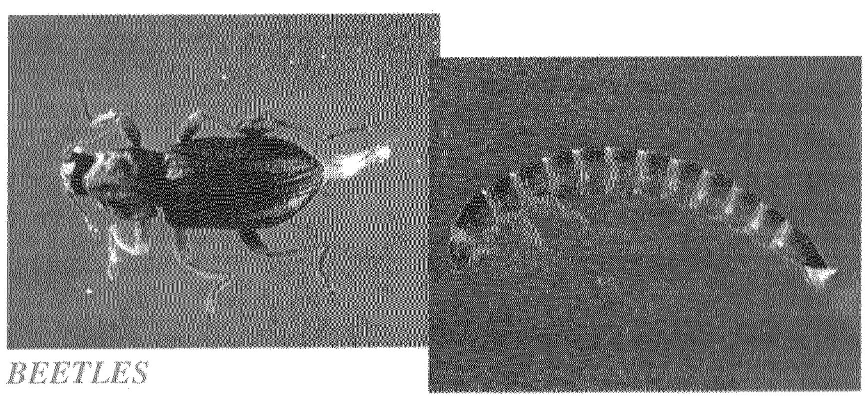
STONEFLIES

Caddisfly larvae often build a portable case of sand, stones, sticks, or other debris. Many caddisfly larvae are sensitive to pollution, although a few are tolerant. One family spins nets to catch drifting plankton, and is often numerous in nutrient-enriched stream segments.



CADDISFLIES

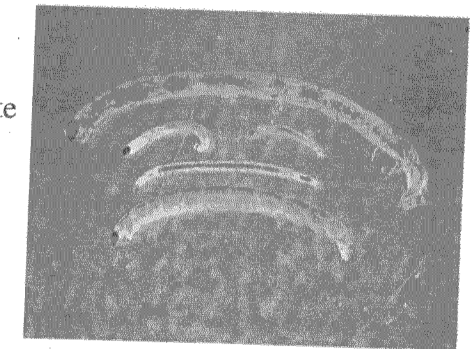
The most common beetles in streams are riffle beetles and water pennies. Most of these require a swift current and an adequate supply of oxygen, and are generally considered clean-water indicators.



BEETLES

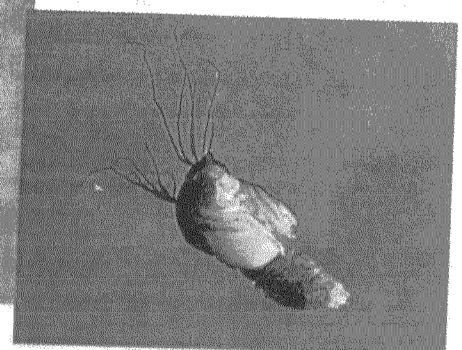
Appendix VII. B.
AQUATIC MACROINVERTEBRATES THAT USUALLY INDICATE POOR WATER QUALITY

Midges are the most common aquatic flies. The larvae occur in almost any aquatic situation. Many species are very tolerant to pollution. Large, red midge larvae called "bloodworms" indicate organic enrichment. Other midge larvae filter plankton, indicating nutrient enrichment when numerous.



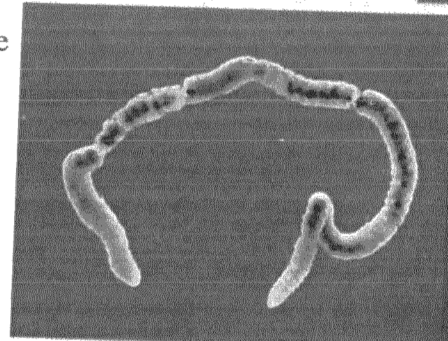
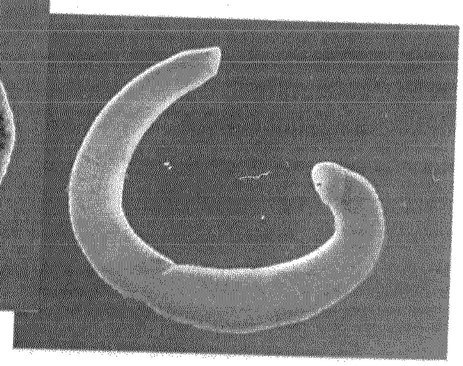
MIDGES

Black fly larvae have specialized structures for filtering plankton and bacteria from the water, and require a strong current. Some species are tolerant of organic enrichment and toxic contaminants, while others are intolerant of pollutants.

BLACK FLIES

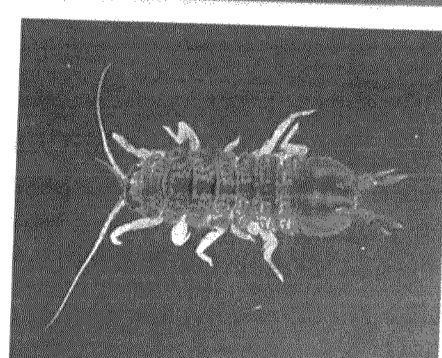
The segmented worms include the leeches and the small aquatic earthworms. The latter are more common, though usually unnoticed. They burrow in the substrate and feed on bacteria in the sediment. They can thrive under conditions of severe pollution and very low oxygen levels, and are thus valuable pollution indicators. Many leeches are also tolerant of poor water quality.

WORMS

Aquatic sowbugs are crustaceans that are often numerous in situations of high organic content and low oxygen levels. They are classic indicators of sewage pollution, and can also thrive in toxic situations.

Digital images by Larry Abele, New York State Department of Environmental Conservation, Stream Biomonitoring Unit.



SOWBUGS

APPENDIX VIII. THE RATIONALE OF BIOLOGICAL MONITORING

Biological monitoring as applied here refers to the use of resident benthic macroinvertebrate communities as indicators of water quality. Macroinvertebrates are larger-than-microscopic invertebrate animals that inhabit aquatic habitats; freshwater forms are primarily aquatic insects, worms, clams, snails, and crustaceans.

<u>Concept</u>

Nearly all streams are inhabited by a community of benthic macroinvertebrates. The species comprising the community each occupy a distinct niche defined and limited by a set of environmental requirements. The composition of the macroinvertebrate community is thus determined by many factors, including habitat, food source, flow regime, temperature, and water quality. The community is presumed to be controlled primarily by water quality if the other factors are determined to be constant or optimal. Community components which can change with water quality include species richness, diversity, balance, abundance, and presence/absence of tolerant or intolerant species. Various indices or metrics are used to measure these community changes. Assessments of water quality are based on metric values of the community, compared to expected metric values.

<u>Advantages</u>

The primary advantages to using macroinvertebrates as water quality indicators are:

1) they are sensitive to environmental impacts
2) they are less mobile than fish, and thus cannot avoid discharges
3) they can indicate effects of spills, intermittent discharges, and lapses in treatment
4) they are indicators of overall, integrated water quality, including synergistic effects and substances lower than detectable limits
5) they are abundant in most streams and are relatively easy and inexpensive to sample
6) they are able to detect non-chemical impacts to the habitat, e.g. siltation or thermal changes
7) they are vital components of the aquatic ecosystem and important as a food source for fish
8) they are more readily perceived by the public as tangible indicators of water quality
9) they can often provide an on-site estimate of water quality
10) they can often be used to identify specific stresses or sources of impairment
11) they can be preserved and archived for decades, allowing for direct comparison of specimens
12) they bioaccumulate many contaminants, so that analysis of their tissues is a good monitor of toxic substances in the aquatic food chain

<u>Limitations</u>

Biological monitoring is not intended to replace chemical sampling, toxicity testing, or fish surveys. Each of these measurements provides information not contained in the others. Similarly, assessments based on biological sampling should not be taken as being representative of chemical sampling. Some substances may be present in levels exceeding ambient water quality criteria, yet have no apparent adverse community impact.

APPENDIX IX. GLOSSARY

assessment: a diagnosis or evaluation of water quality

benthos: organisms occurring on or in the bottom substrate of a waterbody

biomonitoring: the use of biological indicators to measure water quality

community: a group of populations of organisms interacting in a habitat

drainage basin: an area in which all water drains to a particular waterbody; watershed

EPT value: the number of species of mayflies, stoneflies, and caddisflies in a sample

facultative: occurring over a wide range of water quality; neither tolerant nor intolerant of poor water quality

fauna: the animal life of a particular habitat

impact: a change in the physical, chemical, or biological condition of a waterbody

impairment: a detrimental effect caused by an impact

index: a number, metric, or parameter derived from sample data used as a measure of water quality

intolerant: unable to survive poor water quality

macroinvertebrate: a larger-than-microscopic invertebrate animal that lives at least part of its life in aquatic habitats

multiplate: multiple-plate sampler, a type of artificial substrate sampler of aquatic macroinvertebrates

organism: a living individual

rapid bioassessment: a biological diagnosis of water quality using field and laboratory analysis designed to allow assessment of water quality in a short turn-around time; usually involves kick sampling and laboratory subsampling of the sample

riffle: wadeable stretch of stream usually with a rubble bottom and sufficient current to have the water surface broken by the flow; rapids

species richness: the number of macroinvertebrate species in a sample or subsample

station: a sampling site on a waterbody

survey: a set of samplings conducted in succession along a stretch of stream

tolerant: able to survive poor water quality

APPENDIX X. METHODS FOR IMPACT SOURCE DETERMINATION

Definition Impact Source Determination (ISD) is the procedure for identifying types of impacts that exert deleterious effects on a waterbody. While the analysis of benthic macroinvertebrate communities has been shown to be an effective means of determining severity of water quality impacts, it has been less effective in determining what kind of pollution is causing the impact. Impact Source Determination uses community types or models to ascertain the primary factor influencing the fauna.

Development of methods The method found to be most useful in differentiating impacts in New York State streams was the use of community types, based on composition by family and genus. It may be seen as an elaboration of Percent Model Affinity (Novak and Bode, 1992), which is based on class and order. A large database of macroinvertebrate data was required to develop ISD methods. The database included several sites known or presumed to be impacted by specific impact types. The impact types were mostly known by chemical data or land use. These sites were grouped into the following general categories: agricultural nonpoint, toxic-stressed, sewage (domestic municipal), sewage/toxic, siltation, impoundment, and natural. Each group initially contained 20 sites. Cluster analysis was then performed within each group, using percent similarity at the family or genus level. Within each group four clusters were identified, each cluster usually composed of 4-5 sites with high biological similarity. From each cluster a hypothetical model was then formed to represent a model cluster community type; sites within the cluster had at least 50 percent similarity to this model. These community type models formed the basis for Impact Source Determination (see tables following). The method was tested by calculating percent similarity to all the models, and determining which model was the most similar to the test site. Some models were initially adjusted to achieve maximum representation of the impact type. New models are developed when similar communities are recognized from several streams.

Use of the ISD methods Impact Source Determination is based on similarity to existing models of community types (see tables following). The model that exhibits the highest similarity to the test data denotes the likely impact source type, or may indicate "natural", lacking an impact. In the graphic representation of ISD, only the highest similarity of each source type is identified. If no model exhibits a similarity to the test data of greater than 50%, the determination is inconclusive. The determination of impact source type is used in conjunction with assessment of severity of water quality impact to provide an overall assessment of water quality.

Limitations These methods were developed for data derived from 100-organism subsamples of traveling kick samples from riffles of New York State streams. Application of the methods for data derived from other sampling methods, habitats, or geographical areas would likely require modification of the models.

NATURAL

	A	B	C	D	E	F	G	H	I	J	K	L	M
PLATYHELMINTHES	-	-	-	-	-	-	-	-	-	-	-	-	-
OLIGOCHAETA	-	-	5	-	5	-	5	5	-	-	-	5	5
HIRUDINEA	-	-	-	-	-	-	-	-	-	-	-	-	-
GASTROPODA	-	-	-	-	-	-	-	-	-	-	-	-	-
SPHAERIIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-
ASELLIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-
GAMMARIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-
Isonychia	5	5	-	5	20	-	-	-	-	-	-	-	-
BAETIDAE	20	10	10	10	10	5	10	10	10	10	5	15	40
HEPTAGENIIDAE	5	10	5	20	10	5	5	5	5	10	10	5	5
LEPTOPHLEBIIDAE	5	5	-	-	-	-	-	-	5	-	-	25	5
EPHEMERELLIDAE	5	5	5	10	-	10	10	30	-	5	-	10	5
Caenis/Tricorythodes	-	-	-	-	-	-	-	-	-	-	-	-	-
PLECOPTERA	-	-	-	5	5	-	5	5	15	5	5	5	5
Psephenus	5	-	-	-	-	-	-	-	-	-	-	-	-
Optioservus	5	-	20	5	5	-	5	5	5	5	-	-	-
Promoresia	5	-	-	-	-	-	25	-	-	-	-	-	-
Stenelmis	10	5	10	10	5	-	-	-	10	-	-	-	5
PHILOPOTAMIDAE	5	20	5	5	5	5	5	-	5	5	5	5	5
HYDROPSYCHIDAE	10	5	15	15	10	10	5	5	10	15	5	5	10
HELICOPSYCHIDAE/ BRACHYCENTRIDAE/ RHYACOPHILIDAE	5	5	-	-	-	20	-	5	5	5	5	5	-
SIMULIIDAE	-	-	-	5	5	-	-	-	-	5	-	-	-
Simulium vittatum	-	-	-	-	-	-	-	-	-	-	-	-	-
EMPIDIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-
TIPULIDAE	-	-	-	-	-	-	-	-	5	-	-	-	-
CHIRONOMIDAE													
Tanypodinae	-	5	-	-	-	-	-	-	5	-	-	-	-
Diamesinae	-	-	-	-	-	-	5	-	-	-	-	-	-
Cardiocladius	-	5	-	-	-	-	-	-	-	-	-	-	-
Cricotopus/ Orthocladius	5	5	-	-	10	-	-	5	-	-	5	5	5
Eukiefferiella/ Tvetenia	5	5	10	-	-	5	5	5	-	5	-	5	5
Parametriocnemus	-	-	-	-	-	-	-	5	-	-	-	-	-
Chironomus	-	-	-	-	-	-	-	-	-	-	-	-	-
Polypedilum aviceps	-	-	-	-	-	20	-	-	10	20	20	5	-
Polypedilum (all others)	5	5	5	5	5	-	5	5	-	-	-	-	-
Tanytarsini	-	5	10	5	5	20	10	10	10	10	40	5	5
TOTAL	100	100	100	100	100	100	100	100	100	100	100	100	100

NONPOINT NUTRIENTS, PESTICIDES

	A	B	C	D	E	F	G	H	I	J
PLATYHELMINTHES	-	-	-	-	-	-	-	-	-	-
OLIGOCHAETA	-	-	-	5	-	-	-	-	-	15
HIRUDINEA	-	-	-	-	-	-	-	-	-	-
GASTROPODA	-	-	-	-	-	-	-	-	-	-
SPHAERIIDAE	-	-	-	5	-	-	-	-	-	-
ASELLIDAE	-	-	-	-	-	-	-	-	-	-
GAMMARIDAE	-	-	-	5	-	-	-	-	-	-
<u>Isonychia</u>	-	-	-	-	-	-	-	5	-	-
BAETIDAE	5	15	20	5	20	10	10	5	10	5
HEPTAGENIIDAE	-	-	-	-	5	5	5	5	-	5
LEPTOPHLEBIIDAE	-	-	-	-	-	-	-	-	-	-
EPHEMERELLIDAE	-	-	-	-	-	-	-	5	-	-
<u>Caenis/Tricorythodes</u>	-	-	-	-	5	-	-	5	-	5
PLECOPTERA	-	-	-	-	-	-	-	-	-	-
<u>Psephenus</u>	5	-	-	5	-	5	5	-	-	-
<u>Optioservus</u>	10	-	-	5	-	-	15	5	-	5
<u>Promoresia</u>	-	-	-	-	-	-	-	-	-	-
<u>Stenelmis</u>	15	15	-	10	15	5	25	5	10	5
PHILOPOTAMIDAE	15	5	10	5	-	25	5	-	-	-
HYDROPSYCHIDAE	15	15	15	25	10	35	20	45	20	10
HELICOPSYCHIDAE/ BRACHYCENTRIDAE/ RHYACOPHILIDAE	-	-	-	-	-	-	-	-	-	-
SIMULIIDAE	5	-	15	5	5	-	-	-	40	-
<u>Simulium vittatum</u>	-	-	-	-	-	-	-	-	5	-
EMPIDIDAE	-	-	-	-	-	-	-	-	-	-
TIPULIDAE	-	-	-	-	-	-	-	-	-	5
CHIRONOMIDAE										
Tanypodinae	-	-	-	-	-	-	5	-	-	5
<u>Cardiocladius</u>	-	-	-	-	-	-	-	-	-	-
<u>Cricotopus/ Orthocladius</u>	10	15	10	5	-	-	-	-	5	5
<u>Eukiefferiella/ Tvetenia</u>	-	15	10	5	-	-	-	-	5	-
<u>Parametriocnemus</u>	-	-	-	-	-	-	-	-	-	-
<u>Microtendipes</u>	-	-	-	-	-	-	-	-	-	20
<u>Polypedilum aviceps</u>	-	-	-	-	-	-	-	-	-	-
<u>Polypedilum</u> (all others)	10	10	10	10	20	10	5	10	5	5
Tanytarsini	10	10	10	5	20	5	5	10	-	10
TOTAL	100	100	100	100	100	100	100	100	100	100

	MUNICIPAL/INDUSTRIAL A	B	C	D	E	F	G	H	TOXIC A	B	C	D	E	F
PLATYHELMINTHES	-	40	-	-	-	5	-	-	-	-	-	-	5	-
OLIGOCHAETA	20	20	70	10	-	20	-	-	-	10	20	5	5	15
HIRUDINEA	-	5	-	-	-	-	-	-	-	-	-	-	-	-
GASTROPODA	-	-	-	-	-	5	-	-	-	5	-	-	-	5
SPHAERIIDAE	-	5	-	-	-	-	-	-	-	-	-	-	-	-
ASELLIDAE	10	5	10	10	15	5	-	-	10	10	-	20	10	5
GAMMARIDAE	40	-	-	-	15	-	5	5	5	-	-	-	5	5
Isonychia	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BAETIDAE	5	-	-	-	5	-	10	10	15	10	20	-	-	5
HEPTAGENIIDAE	5	-	-	-	-	-	-	-	-	-	-	-	-	-
LEPTOPHLEBIIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EPHEMERELLIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Caenis/Tricorythodes	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PLECOPTERA	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Psephenus	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Optioservus	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Promoresia	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stenelmis	5	-	-	10	5	-	5	5	10	15	-	40	35	5
PHILOPOTAMIDAE	-	-	-	-	-	-	-	40	10	-	-	-	-	-
HYDROPSYCHIDAE	10	-	-	50	20	-	40	20	20	10	15	10	35	10
HELICOPSYCHIDAE/ BRACHYCENTRIDAE/ RHYACOPHILIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SIMULIIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Simulium vittatum	-	-	-	-	-	-	20	10	-	20	-	-	-	5
EMPIDIDAE	-	5	-	-	-	-	-	-	-	-	-	-	-	-
CHIRONOMIDAE														
Tanypodinae	-	10	-	-	5	15	-	-	5	10	-	-	-	25
Cardiocladius	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cricotopus/ Orthocladius	5	10	20	-	5	10	5	5	15	10	25	10	5	10
Eukiefferiella/ Tvetenia	-	-	-	-	-	-	-	-	-	-	20	10	-	-
Parametriocnemus	-	-	-	-	-	-	-	-	-	-	-	5	-	-
Chironomus	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Polypedilum aviceps		-	-	-	-	-	-	-	-	-	-	-	-	- -
Polypedilum (all others)	-	-	-	10	20	40	10	5	10	-	-	-	-	5
Tanytarsini	-	-	-	10	10	-	5	-	-	-	-	-	-	5
TOTAL	100	100	100	100	100	100	100	100	100	100	100	100	100	100

SEWAGE EFFLUENT, ANIMAL WASTES

	A	B	C	D	E	F	G	H	I	J
PLATYHELMINTHES	-	-	-	-	-	-	-	-	-	-
OLIGOCHAETA	5	35	15	10	10	35	40	10	20	15
HIRUDINEA	-	-	-	-	-	-	-	-	-	-
GASTROPODA	-	-	-	-	-	-	-	-	-	-
SPHAERIIDAE	-	-	-	10	-	-	-	-	-	-
ASELLIDAE	5	10	-	10	10	10	10	50	-	5
GAMMARIDAE	-	-	-	-	-	10	-	10	-	-
Isonychia	-	-	-	-	-	-	-	-	-	-
BAETIDAE	-	10	10	5	-	-	-	-	5	-
HEPTAGENIIDAE	10	10	10	-	-	-	-	-	-	-
LEPTOPHLEBIIDAE	-	-	-	-	-	-	-	-	-	-
EPHEMERELLIDAE	-	-	-	-	-	-	-	-	5	-
Caenis/Tricorythodes	-	-	-	-	-	-	-	-	-	-
PLECOPTERA	-	-	-	-	-	-	-	-	-	-
Psephenus	-	-	-	-	-	-	-	-	-	-
Optioservus	-	-	-	-	-	-	-	-	5	-
Promoresia	-	-	-	-	-	-	-	-	-	-
Stenelmis	15	-	10	10	-	-	-	-	-	-
PHILOPOTAMIDAE	-	-	-	-	-	-	-	-	-	-
HYDROPSYCHIDAE	45	-	10	10	10	-	-	10	5	-
HELICOPSYCHIDAE/ BRACHYCENTRIDAE/ RHYACOPHILIDAE	-	-	-	-	-	-	-	-	-	-
SIMULIIDAE	-	-	-	-	-	-	-	-	-	-
Simulium vittatum	-	-	-	25	10	35	-	-	5	5
EMPIDIDAE	-	-	-	-	-	-	-	-	-	-
CHIRONOMIDAE										
Tanypodinae	-	5	-	-	-	-	-	-	5	5
Cardiocladius	-	-	-	-	-	-	-	-	-	-
Cricotopus/ Orthocladius	-	10	15	-	-	10	10	-	5	5
Eukiefferiella/ Tvetenia	-	-	10	-	-	-	-	-	-	-
Parametriocnemus	-	-	-	-	-	-	-	-	-	-
Chironomus	-	-	-	-	-	-	10	-	-	60
Polypedilum aviceps	-	-	-	-	-	-	-	-	-	-
Polypedilum (all others)	10	10	10	10	60	-	30	10	5	5
Tanytarsini	10	10	10	10	-	-	-	10	40	-
TOTAL	100	100	100	100	100	100	100	100	100	100

	SILTATION					IMPOUNDMENT									
	A	B	C	D	E	A	B	C	D	E	F	G	H	I	J
PLATYHELMINTHES	-	-	-	-	-	-	10	-	10	-	5	-	50	10	-
OLIGOCHAETA	5	-	20	10	5	5	-	40	5	10	5	10	5	5	-
HIRUDINEA	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-
GASTROPODA	-	-	-	-	-	-	-	10	-	5	5	-	-	-	-
SPHAERIIDAE	-	-	-	5	-	-	-	-	-	-	-	-	5	25	-
ASELLIDAE	-	-	-	-	-	-	5	5	-	10	5	5	5	-	-
GAMMARIDAE	-	-	-	10	-	-	-	10	-	10	50	-	5	10	-
Isonychia	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BAETIDAE	-	10	20	5	-	-	5	-	5	-	-	5	-	-	5
HEPTAGENIIDAE	5	10	-	20	5	5	5	-	5	5	5	5	-	5	5
LEPTOPHLEBIIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EPHEMERELLIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Caenis/Tricorythodes	5	20	10	5	15	-	-	-	-	-	-	-	-	-	-
PLECOPTERA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Psephenus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5
Optioservus	5	10	-	-	-	-	-	-	-	-	-	-	-	5	-
Promoresia	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stenelmis	5	10	10	5	20	5	5	10	10	-	5	35	-	5	10
PHILOPOTAMIDAE	-	-	-	-	-	5	-	-	5	-	-	-	-	-	30
HYDROPSYCHIDAE	25	10	-	20	30	50	15	10	10	10	10	20	5	15	20
HELICOPSYCHIDAE/ BRACHYCENTRIDAE/ RHYACOPHILIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-
SIMULIIDAE	5	10	-	-	5	5	-	5	-	35	10	5	-	-	15
EMPIDIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CHIRONOMIDAE															
Tanypodinae	-	-	-	-	-	-	5	-	-	-	-	-	-	-	-
Cardiocladius	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cricotopus/ Orthocladius	25	-	10	5	5	5	25	5	-	10	-	5	10	-	-
Eukiefferiella/ Tvetenia	-	-	10	-	5	5	15	-	-	-	-	-	-	-	-
Parametriocnemus	-	-	-	-	-	5	-	-	-	-	-	-	-	-	-
Chironomus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Polypedilum aviceps	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Polypedilum (all others)	10	10	10	5	5	5	-	-	20	-	-	5	5	5	5
Tanytarsini	10	10	10	10	5	5	10	5	30	-	-	5	10	10	5
TOTAL	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100